SCIENCE

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*ON A NEW CONSTITUENT OF ATMOSPHERIC AIR.**

THIS preliminary note is intended to give a very brief account of experiments which have been carried out during the past year to ascertain whether, in addition to nitrogen, oxygen and argon, there are any gases in air which have escaped observation owing to their being present in very minute quantity. In collaboration with Miss Emily Aston we have found that the nitride of magnesium, resulting from the absorption of nitrogen from atmospheric air, on treatment with water yields only a trace of gas; that gas is hydrogen, and arises from a small quantity of metallic magnesium unconverted into nitride. That the ammonia produced on treatment with water is pure has already been proved by the fact that Lord Rayleigh found that the nitrogen produced from it had the normal density. The magnesia, resulting from the nitride, yields only a trace of soluble matter to water, and that consists wholly of hydroxide and carbonate. So far, then, the results have been negative.

Recently, however, owing to the kindness of Dr. Hampson, we have been furnished with about 750 cubic centimeters of liquid air, and, on allowing all but 10 cubic centimeters to evaporate away slowly, and, col-

*Paper read before the Royal Society on June 9th by Professor William Ramsay, F. R S., and Morris W. Travers. Received by the Society June 3d. Reprinted from *Nature*.

lecting the gas from that small residue in a gas holder, we obtained, after removal of oxygen with metallic copper and nitrogen with a mixture of pure lime and magnesium dust, followed by exposure to electric sparks in presence of oxygen and caustic soda, 26.2 cubic centimeters of a gas, showing the argon spectrum feebly, and, in addition, a spectrum which has, we believe, not been seen before.

We have not yet succeeded in disentangling the new spectrum completely from the argon spectrum, but it is characterized by two very brilliant lines, one almost identical in position with D_3, and almost rivalling it in brilliancy. Measurements made with a grating of 14,438 lines to the inch, kindly placed at our disposal by Mr. E. C. C. Baly, gave the following numbers, *all four lines being in the field at once:*

D_1	... ...	5895.0
D_2	... ...	5889.0
D_3	... ...	5875.9
D_4	... ...	5866.65 + 1.7 to correct to vacuum.

There is also a green line, comparable with the green helium line in intensity, of wave-length 5566.3, and a somewhat weaker green, the wave-length of which is 5557.3.

In order to determine, as far as possible, which lines belong to the argon spectrum, and which to the new gas, both spectra were examined at the same time with the grating, the first order being employed. The lines which were absent, or very feeble, in argon have been ascribed to the new gas. Owing to their feeble intensity, the measurements of the wave-lengths which follow must not be credited with the same degree of accuracy as the three already given, but the first three digits may be taken as substantially correct:

Violet	... ..	4317	Blue	... ...	4834
"	... ...	4387	"	... ...	4909
"	... ...	4461	Green	... ...	5557.3
"	... ...	4671	"	... ...	5566.3
Blue	... ...	4736	Yellow	... ...	5829
"	.. ...	4807	"	... ...	5866.5
"	... ...	4830	Orange	... ...	6011

Mr. Baly has kindly undertaken to make a study of the spectrum, which will be published when complete. The figures already given, however, suffice to characterise the gas as a new one.

The approximate density of the gas was determined by weighing it in a bulb of 32.321 cubic centimeters' capacity, under a pressure of 521.85 millimeters, and at a temperature of 15.95°. The weight of this quantity was 0.04213 gram. This implies a density of 22.47, that of oxygen being taken as 16. A second determination, after sparking for four hours with oxygen in presence of soda, was made in the same bulb; the pressure was 523.7 millimeters, and temperature was 16.45°. The weight was 0.04228 gram, which implies the density 22.51.

The wave-length of sound was determined in the gas by the method described in the 'Argon' paper. The data are:

	i.	ii.	iii.
Wave-length in air	34.17	34.30	34.57
" " gas	29.87	30.13	

Calculating by the formula

$$\lambda^2_{air} \times \text{density}_{air} : \lambda^2_{gas} \times \text{density}_{gas} :: \gamma_{air} : \gamma_{gas}$$
$$(34.33)^2 \times 14.479 : (30)^2 \times 22.47 :: 1.408 : 1.666$$

it is seen that, like argon and helium, the new gas is monatomic and therefore an element.

From what has preceded, it may be concluded that the atmosphere contains a hitherto undiscovered gas with a characteristic spectrum, heavier than argon, and less volatile than nitrogen, oxygen and argon; the ratio of its specific heats would lead to the inference that it is monatomic and therefore an element. If this conclusion turns out to be well substantiated we propose to call it 'krypton,' or 'concealed.' Its symbol would then be Kr.

It is, of course, impossible to state positively what position in the periodic table this new constituent of our atmosphere will

occupy. The number 22.51 must be taken as a minimum density. If we may hazard a conjecture it is that krypton will turn out to have the density 40, with a corresponding atomic weight 80, and will be found to belong to the helium series, as is, indeed, rendered probable by its withstanding the action of red-hot magnesium and calcium on the one hand, and on the other of oxygen in presence of caustic soda, under the influence of electric sparks. We shall procure a larger supply of the gas and endeavor to separate it more completely from argon by fractional distillation.

It may be remarked in passing that Messrs. Kayser and Friedlander, who supposed that they had observed D_3 in the argon of the atmosphere, have probably been misled by the close proximity of the brilliant yellow line of krypton to the helium line.

On the assumption of the truth of Dr. Johnstone Stoney's hypothesis that gases of a higher density than ammonia will be found in our atmosphere, it is by no means improbable that a gas lighter than nitrogen will also be found in air. We have already spent several months in preparation for a search for it, and will be able to state ere long whether the supposition is well founded.

LIQUID HYDROGEN.

PRELIMINARY NOTE ON THE LIQUEFACTION OF HYDROGEN AND HELIUM.*

IN a paper entitled 'The Liquefaction of Air and Research at Low temperatures," read before the Chemical Society, and published in their 'Proceedings,' No. 158, an account is given of the history of the hydrogen problem and the result of my own experiments up to the end of the year 1895. The subject is again discussed in a Friday Evening Lecture on 'New Researches on Liquid Air,'* which contains a drawing of the apparatus employed for the production of a jet of hydrogen containing liquid. It was shown that such a jet could be used to cool bodies below the temperature that could be reached by the use of liquid air, but all attempts to collect the liquid in vacuum vessels failed. No other investigator has so far improved on the results described in 1895. The type of apparatus used in these experiments worked well, so it was resolved to construct a much larger liquid air plant, and to combine with it circuits and arrangements for the liquefaction of hydrogen, which will be described in a subsequent paper. This apparatus, admirably constructed by the engineers, Messrs. Lennox, Reynolds, and Fyfe, took a year to build up, and many months have been occupied in testing and making preliminary trials. The many failures and defeats need not be detailed.

On May 10th, starting with hydrogen cooled to —205° C., and under a pressure of 180 atmospheres, escaping continuously from the nozzle of a coil of pipe at the rate of about 10 cubic feet to 15 cubic feet per minute, in a vacuum vessel double-silvered and of special construction, all surrounded with a space kept below —200° C., liquid hydrogen commenced to drop from this vacuum vessel into another doubly isolated by being surrounded with a third vacuum vessel. In about five minutes, 20 cc. of liquid hydrogen were collected, when the hydrogen jet froze up from the solidification of air in the pipes. The yield of liquid was about 1 per cent. of the gas. The hydrogen in the liquid condition is clear and colorless, showing no absorption spectrum, and the meniscus is as well defined as in the case of liquid air. The liquid has a relatively high refractive index and dispersion, and the density appears to be in excess of the theoretical density, viz., 0.18 to 0.12, which we

*Read before the Royal Society, London, May 12, 1898.

*'Roy. Inst. Proc.,' 1886.

deduce respectively from the atomic volume of organic compounds and the limiting density found by Amagat for hydrogen gas under infinite compression. My old experiments on the density of hydrogen in palladium gave a value for the combined body of 0.62, and it will be interesting to find the real density of the liquid substance at its boiling point. Not having arrangements at hand to determine the boiling point, two experiments were made to prove the excessively low temperature of the boiling fluid. In the first place, if a long piece of glass tubing, sealed at one end and open to the air at the other, is cooled by immersing the closed end in the liquid hydrogen, the tube immediately fills, where it is cooled, with solid air. The second experiment was made with a tube containing helium.

The 'Cracow Academy Bulletin' for 1896 contains a paper by Professor Olszewski, entitled 'A Research on the Liquefaction of Helium,' in which he states 'as far as my experiments go, helium remains a permanent gas and apparently is much more difficult to liquefy than hydrogen.' In a paper of my own in the 'Proceedings of the Chemical Society,' No. 183 (1896–7), in which the separation of helium from Bath gas was effected by a liquefaction method, the suggestion was made that the volatility of hydrogen and helium would probably be found close together, just like those of fluorine and oxygen. Having a specimen of helium which had been extracted from Bath gas, sealed up in a bulb with a narrow tube attached, the latter was placed in liquid hydrogen, when a distinct liquid was seen to condense. A similar experiment made with the use of liquid air under exhaustion in the same helium tube (instead of liquid hydrogen) gave no visible condensation. From this result it would appear that there cannot be any great difference in the boiling points of helium and hydrogen.

All known gases have now been condensed into liquids which can be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels. With hydrogen as a cooling agent we shall get within 20° or 30° of the zero of absolute temperature, and its use will open up an entirely new field of scientific inquiry. Even as great a man as James Clerk Maxwell had doubts as to the possibility of ever liquefying hydrogen.* No one can predict the properties of matter near the zero of temperature. Faraday liquefied chlorine in the year 1823. Sixty years afterwards Wroblewski and Olszewski produced liquid air, and now, after a fifteen years' interval, the remaining gases, hydrogen and helium, appear as static liquids. Considering that the step from the liquefaction of air to that of hydrogen is relatively as great in the thermo-dynamic sense as that from liquid chlorine to liquid air, the fact that the former result has been achieved in one-fourth the time needed to accomplish the latter, proves the greatly accelerated rate of scientific progress in our time.

The efficient cultivation of this field of research depends upon combination and assistance of an exceptional kind; but in the first instance money must be available and the members of the Royal Institution deserve my especial gratitude for their handsome donations to the conduct of this research. Unfortunately its prosecution will demand a further large expenditure. The handsome contribution made by the Goldsmiths' Company ought also to be mentioned as very materially helping the progress of the work.

During the whole course of the low temperature work carried out at the Royal Institution the invaluable aid of Mr. Robert Lennox has been at my disposal; and it is not too much to say that but for his engi-

* See 'Scientific Papers,' Vol. 2, p. 412.

neering skill, manipulative ability and loyal perseverance the present successful issue might have been indefinitely delayed. My thanks are also due to Mr. J. W. Heath for valuable assistance in the conduct of these experiments.

THE BOILING POINT AND DENSITY OF LIQUID HYDROGEN.*

THE boiling point of liquid hydrogen at atmospheric pressure has been determined by a platinum resistance thermometer. This was constructed of pure metal and had a resistance of 5.3 ohms at 0° C., which fell to about 0.1 ohm when the thermometer was immersed in liquid hydrogen. On reduction of this resistance to normal air temperatures the boiling point is found to be —238.2° and —238.9° respectively by two methods, and to be —237° by a Dickson formula calculated for this thermometer (*cf. Phil. Mag.*, 1898, 45, 525). The boiling point of the liquid is, therefore, about —238° C., or 35° absolute, and is thus about 5° higher than that obtained by Olszewski by the adiabatic expansion of the compressed gas, and about 8° higher than that deduced by Wroblewski from van der Waals' equation. It may be inferred that the critical point of hydrogen is about 50° absolute, and that the critical pressure will probably not exceed 15 atmospheres. As molecular latent heats are proportional to absolute boiling points, the latent heat of liquid hydrogen will be about two-fifths that of liquid oxygen. From analogy it is probable that the practicable lowering of temperature to be obtained by evaporating liquid hydrogen under pressures of a few mm. cannot amount to more than 10–12° C., and it may be said with certainty that no means are at present known for approaching nearer than 20–25° to the absolute zero of temperature. The platinum resistance thermometer used had a zero point of —263.2 platinum degrees, and when immersed in boiling liquid hydrogen indicated a temperature of —256.8° on the same scale, or 6.4 platinum degrees from the point at which the metal would become a perfect conductor. The effect of cooling platinum from the boiling point of liquid oxygen to that of liquid hydrogen is to diminish its resistance to one-eleventh.

The approximate density of liquid hydrogen at its boiling point was determined by measuring the volume of the gas obtained by evaporating 10 cc. and is slightly less than 0.07, or about one-sixth that of liquid marsh gas, which has a density of 0.41 and is the lightest liquid at its boiling point hitherto known. It is remarkable that, with so low a density, liquid hydrogen is so easily seen, has so well defined a meniscus, and can be so readily collected and manipulated in vacuum vessels. As hydrogen occluded in palladium has a density of 0.62, it follows that it must be associated with the metal in some other state than that of liquefaction. The atomic volume of liquid hydrogen at the boiling point is about 14.3, atomic volumes of liquid oxygen and nitrogen being 13.7 and 16.6, respectively, at their boiling points. The density of the gas at the boiling point of liquid hydrogen is 0.55, or about one-half that of air, and is eight times that of the gas at ordinary temperatures. The ratio of the density of hydrogen gas at the boiling point to that of the liquid is approximately 1 : 100, as compared with a ratio of 1 : 255 in the case of oxygen.

The specific heat of hydrogen in the gaseous state and in hydrogenized palladium is 3.4, but may very probably be 6.4 in the liquid substance. Such a liquid would be unique in its properties, but as the volume of one gram of liquid hydrogen is about 14–15 cc. the specific heat per unit volume must be nearly 0.5, which is about that of liquid air. It is highly pro-

*Read before the Chemical Society, London, on June 2, 1898.

bable, therefore, that the remarkable properties of liquid hydrogen predicted by theory will prove to be susceptible of explanation when they are compared with those of liquid air, volume for volume, at corresponding temperatures as defined by van der Waals.

James Dewar.

Royal Institution, London.

THE SPECIFIC HEAT OF METALS AT LOW TEMPERATURES.

Dr. Wolcott Gibbs having requested Professor Rood to make some determinations of the specific heat of a few metals, employing liquid air, the matter was finally handed over to me by Professor Rood, and I herewith give a short account of the method used and the results obtained.

Few experiments on the specific heat of substances at low temperatures have been made. The chief cause of this has been the difficulty experienced heretofore in reducing the temperature of bodies to a definite number of degrees sufficiently below zero, Centigrade. Liquid air affords a means of obtaining a very low temperature, and was procured through the kindness of Mr. Charles E. Tripler, who has devised apparatus for making it in considerable quantities.

In a paper on the liquefaction of gases by Professor Charles Olszewski, in the *Philosophical Magazine*, London, February, 1895, Vol. XXXIX., No. CCXXXVII., pp. 188–212, it is stated, that the boiling point of liquefied air under atmospheric pressure is —191.4°C., that of liquefied nitrogen —194.4°C., and that of liquefied oxygen —181.4°C. These temperatures were determined with a hydrogen thermometer, and are generally accepted as correct.

Liquefied air changes in composition when in a state of ebullition, the percentage of nitrogen contained in it diminishing, while that of oxygen increases.

This change occurs because liquid nitrogen is the more volatile of the two liquid gases, and boils away at a higher rate than liquid oxygen; consequently liquid air changes in temperature. If it is allowed to boil for a considerable time it becomes almost pure liquid oxygen and its temperature correspondingly approaches near the boiling point of that liquid gas, or —181.4°C.

Such was the case with the liquefied air procured for the experiments on specific heat; therefore, after standing several hours, the cold liquid employed by me was considered to be liquid oxygen and its temperature —181.4°C.

A series of determinations were made of the specific heat of copper, iron and aluminium between the boiling point of liquid oxygen (—181.4°C.) and about 13 degrees Centigrade.

The method of mixtures was employed and was applied in a manner suggested by Professor Rood.

The experiments were conducted as follows:

A piece of metal of known weight was immersed in liquid oxygen (—181.4°C.); after it had cooled down to the temperature of the liquid, it was lifted out by a silk thread attached to it, and transferred quickly to a calorimeter containing water of known weight and temperature.

The loss in temperature of the water, due to the insertion of the cold substance, was carefully noted, and the specific heat of the metal computed.

Various precautions were taken to avoid errors in the results, and the usual corrections were applied in the calculations.

Before the determinations of the specific heat of metals between the boiling point of liquid oxygen and normal temperatures (about 13°C.) were begun, a series of experiments were performed on the specific heat of copper between 23°C. and the boiling point of water (100°C.), under condi-

tions as far as possible identical with those anticipated in the experiments with liquid oxygen.

By this means it was ascertained approximately what degree of accuracy could be expected in the results when liquid oxygen was employed.

The manipulation in these preliminary experiments was as follows:

A piece of copper, with a silk thread attached (the identical piece to be used in the low temperature experiments), was immersed in boiling water and allowed to remain submerged for several minutes.

It was then lifted out of the boiling water by the thread, and conveyed as quickly as possible to a calorimeter two-thirds filled with water at 17°C. The rise in the temperature of the water was noted, and the specific heat calculated in the usual way. When the copper was transferred from the vessel containing the boiling water to the calorimeter, it was allowed to strike the edge of the vessel a sharp blow to remove drops of water remaining on the surface of the piece of copper.

It was found, however, that a small amount of hot water, .03 to .04 of a gram, was always carried over to the calorimeter. The quantity was determined experimentally and the proper correction applied in the specific heat calculations.

Five consecutive determinations of the specific heat of copper between 23° C. and the boiling point of water (100° C.), by this method, were as follows:

TABLE 1.

Substance.	Determination Number.	Specific Heat. 23°...100° C.
Copper.	1	.09262
"	2	.09463
"	3	.09399
"	4	.09394
"	5	.09517
	Mean	.0940

Average variation of the five determinations from the mean .0006, or .7 per cent.

Greatest variation of any one determination from the mean, .00138, or 1.5 per cent.

The weight of water used in each determination was 70.00 grams, and the water equivalent of the calorimeter and thermometer, 5.87 grams.

The weight of copper employed in each determination was 63.493 grams.

The temperature of the boiling water was determined from the atmospheric pressure, the barometric height being measured at intervals during the experiments.

The mean value obtained for the specific heat of copper, .0940, is in agreement with the value generally accepted for that metal for the same range of temperature, the best values ranging from .0933 to .0949.

Also the percentage error of each determination as compared with the mean value, .0940, is small, being less than 1 per cent.

These facts seemed to warrant proceeding with a series of determinations of the specific heat of copper and other metals at low temperatures by the same method, employing liquid oxygen.

Five determinations of the specific heat of copper between the boiling point of liquid oxygen, under atmospheric pressure (—181.4°C.), and 11 C. were as follows:

TABLE 2.

Substance.	Determination. Number.	Specific Heat (-181.4°... 11°C.)
Copper.	1	.0867
"	4	.0854
"	7	.0882
"	10	.0873
"	13	.0868
	Mean	.0868

Average variation of the five determinations from the mean, .0007, or .8 per cent.

Greatest variation of any one determination from the mean, .0014, or 1.6 per cent.

Weight of water used in each determination, 70.01 grams.

Weight of copper used in each determination, 63.493 grams.

By these experiments the specific heat of copper between —181.4° and 11° C. was found to be .0868.

As previously stated, the specific heat of copper between 23° and 100° C. was found to be .0940.

The two sets of determinations were made by the same method, the accuracy of manipulation in each being about equal, and the same piece of copper was used for both ranges of temperature.

A comparison of the two values shows the specific heat of copper between —181.4° and 11° C. to be 7.6 per cent. less than that found in determinations between 23° and 100° C.

The specific heat of iron between —181.4° and 13° C. and that of aluminium between —181.4° and 15° C. were also found.

Five determinations of the specific heat of iron between —181.4° and 13° C. were as follows:

Table 3.

Substance.	Determination Number.	Specific Heat. (−181.4°...13° C).
Iron.	3	.0890
"	5	.0883
"	8	.0949
"	11	.0912
"	14	.0939
	Mean	.0914

Average variation of the five determinations from the mean .0025, or 2.4 per cent.

Greatest variation of any one determination from the mean, .0035, or 3.8 per cent.

Weight of water employed in each determination, 70.01 grams.

Weight of iron, 51.93 grams.

Five determinations of the specific heat of aluminium between —181.4° and 15° C. were as follows:

Table 4.

Substance.	Determination Number.	Specific Heat. (−181.4°...15° C).
Aluminium.	2	.1814
"	6	.1827
"	9	.1851
"	12	.1815
"	15	.1861
	Mean	.1833

Average variation of the five determinations from the mean, .0018, or 1 per cent.

Greatest variation of any one determination from the mean, .0028, or 1.5 per cent.

Weight of water employed in each determination, 70.01 grams.

Weight of aluminium, 19.86 grams.

All of these experiments on specific heat, employing liquid oxygen, were performed consecutively, without interruption.

The determinations were made alternately, and with one exception in the order: copper, iron, aluminium.

The 'determination number' in the foregoing tables of the specific heats of the metals between 181.4° and about 13° C. shows the order followed.

By this arrangement any change in the temperature of the cold liquid used (liquid oxygen), during the time occupied in performing the experiments, would have been indicated in the results obtained. No such indication is apparent.

The assumption made that the liquid employed had already been transformed by ebullition from liquid air to liquid oxygen was, therefore, virtually substantiated.

Liquid oxygen placed in a vessel surrounded by air at ordinary temperatures boils away rapidly; consequently in the foregoing experiments it was contained in a cylindrical copper receptacle, set inside of another about twice the diameter of the first, which also contained liquid oxygen. With this arrangement the oxygen in the inner receptacle can be made to cease boiling.

This simple method of rendering liquid

gases free from ebullition has been employed by Mr. Charles E. Tripler, and was adopted in the present investigation with a slight modification; the liquid oxygen in the inner receptacle being kept always at a higher level than that in the outer, allowed feeble ebullition in the inner vessel and assured the liquid therein being at its boiling point.

The same weight of water to a gram was used in the calorimeter throughout the experiments of both the specific heat at low temperatures and those between 23° and 100°C., and also in determining the water equivalent of the calorimeter and thermometer.

It was found necessary to filter the liquid oxygen in which the metals were immersed, in order to free it from the solid matter that was present in the liquid. Unless this precautionary measure had been adopted, some of the frozen masses of carbondioxide, water and other compounds that are in unfiltered liquid oxygen would have adhered to the metals (as was found by experiment), and would have affected the accuracy of the determinations.

The metallic objects of which the specific heat was determined were cylindrical in form and all about equal in volume. The measurements of each were as follows:

Copper—Length, 5.5 cms.; diameter, 1.2 cms.; weight, 63.493 grams.

Iron—Length, 5.5 cms.; diameter, 1.2 cms.; weight, 51.93 grams.

Aluminium—Length, 5.6 cms.; diameter, 1.2 cms.; weight, 19.86 grams.

These pieces were specially constructed on a lathe, and were made with rounded instead of flat ends, so that the liquid oxygen and boiling water would be less apt to adhere to them when they were lifted from these liquids. A small button was turned on the end of each of the metal pieces in construction, and to this a silk thread was attached for transferring them from the hot or cold liquids to the water in the calorimeter in the two series of experiments. It was considered unadvisable to bore holes in the metal pieces through which to fasten the threads, because drops of the liquids would have been caught in such recesses.

In all of the above experiments with liquid oxygen, before the metals were transferred from the liquid oxygen to the water in the calorimeter, the water was heated a few degrees above the room temperature. The amount that it was thus previously raised was approximately equal to half the number of degrees that the water would fall in temperature when the cold metal was placed in it.

A value for this fall of temperature was determined by a preliminary experiment.

By this means changes in temperature of the water and calorimeter, due to radiation and conduction of heat, and caused by a difference in temperature existing between them and surrounding bodies, were approximately compensated for.

The method of eliminating errors arising from causes similar to those just under consideration was originated by Rumford.

In calculating the values of the specific heats in the above experiments it was assumed that the temperature of the metals in transference from the liquid oxygen to the water in the calorimeter did not change to an appreciable amount. This assumption was apparently substantiated by the following experiments:

The metals were lifted out of the liquid oxygen, and again immersed after a period of two seconds. It was noted that no boiling whatever could be observed as they were replaced in the liquid. In ten observations made with a watch provided with stop attachment, in which the time that the metals were held out of the liquid air varied from $1\frac{3}{5}$ sec. to $2\frac{1}{5}$ sec., no boiling was perceived when they were replaced in the liquid.

With an extension of the time that the metals were held out of the liquid to three seconds, a slight effect of boiling was apparent when they were replaced.

In the determinations of specific heats for low temperatures it required only one second or less to transfer the metals from the liquid oxygen to the water in the calorimeter. It, therefore, seems probable that little heat was absorbed by the substances during the time required for their transference from the liquid oxygen to the calorimeter. In the experiments with liquid oxygen transference of the metalic objects from the cold liquid to the water in the calorimeter was accomplished with less difficulty than the transference of the same objects from boiling water to the water in the calorimeter, as performed in the preliminary experiments on the specific heat of copper between 23° and 100° C.

Little or no liquid oxygen was carried over to the calorimeter on the metal pieces, it having boiled off before they were placed in the water; therefore a correction similar to that applied in the experiments with boiling water was not necessary.

The value of the specific heat of iron between —181.4° and 13°, C.,as determined by the foregoing experiments, is .0914.

The lowest value for the range, 15°... 100° C., according to recorded results, appears to be about .113 (.1130, 0°...100° C., Tomlinson).

The value for the specific heat of iron between —181.4° and 13° is, therefore,approximately 19 per cent. less than the lowest value for the range, 15°···100° C.

The specific heat of aluminium for the low temperature range was found to be .1833.

The lowest value for the range 15°···100° C. seems to be about .212 (15°···97° C., Regnault).

The value for the specific heat of this metal between —181.4° and 15° C. is 13.6 per cent. less than the lowest value for the range 15°···100° (97°) C.

The values for the specific heat for the ranges, 0°···100° C. and 15°···97° C. given, were taken from *Physikalish-chemische Tabellen*, by Landolt and Börnstein, 1894 Ed.

The variation in the values, as given by different authors, of the specific heat of certain metals for the range 15°···100° C. is no doubt partly due to the employment of metals of different degrees of purity. For this reason the specific heat of the pieces of iron and aluminium used in the experiments with liquid oxygen have been determined between 23° and 100° C. in the manner that the specific heat of the copper for the same range was found.

The determinations were as follows:

Table 5.

Substance.	Determination Number.	Specific Heat. (23°···100° C.)
Iron.	16	.1175
"	17	.1151
"	18	.1185
"	19	.1164
"	20	.1136
	Mean	.1162

The weight of water and other quantities were the same in these experiments as those with copper (23°···100°C.).

The determinations of the specific heat of aluminium between 23°···100° C. were as follows:

Table 6.

Substance.	Determination Number.	Specific Heat. (23°···100° C.)
Aluminium.	21	.2190
"	22	.2165
"	23	.2225
"	24	.2128
"	25	.2158
	Mean	.2173

The accuracy of manipulation in these two sets of determinations was about equal to that of the experiments on copper for the same range of temperature.

If the results of the determinations just given and those for copper for the same range, 23°···100° C., are employed, a comparison can be made between the specific heat of pieces of certain metals (copper, iron, and aluminum) determined between —181.4° C. and 13° C. and the specific heat of the same pieces of metal determined between 23° and 100° C., by the same method.

The following table has been arranged to show this comparison :

TABLE 7.

Metal.	Specific Heat. −181.4°···13° C., (employing liquid oxygen).	Specific Heat. 23°···100° C., (employing boiling water).	Actual difference between two values.	Percentage difference between two values.
Copper.	.0868	.0940	.0072	7.6 %
Iron.	.0914	.1162	.0248	21.3 %
Aluminium.	.1833	.2173	.0340	15.7 %

It is shown by this table that the specific heat of copper, iron and aluminium between —181.4°C. and about 13°C. were found to be, respectively, .0868, .0914 and .1833, or 7.6, 21.3 and 15.7 per cent. less than the specific heat of these metals determined between 23° and 100°C.

An error of several degrees in the low temperature value (—181.4°C.) would affect the accuracy of these results only to a small amount. If, for example, the specific heat of iron for the low range of temperature is assumed to be the same as between 23° and 100°C. it would mean that an error of over 40 degrees had been made, which is obviously impossible. If there are errors in the results given above, the present indications are that they are less than one per cent.

The value of the water equivalent of the calorimeter and thermometer finally used in the calculations in all the specific heat experiments was obtained from the mean of ten determinations. The mean value was 5.87 grams.

The calorimeter was made of copper, cylindrical in form ; height, 9.75 cms.; diameter, 4.0 cms.; and weight, 35.498 grams.

The thermometer was one made by Henry J. Green, No. 8407, graduated to $\frac{1}{20}$ of a degree Centigrade, and could be read to $\frac{1}{100}$ of a degree.

C. C. TROWBRIDGE.

COLUMBIA UNIVERSITY, June 16, 1898.

THE FLICKER PHOTOMETER.

PROFESSOR ROOD'S interesting article in SCIENCE of June 3d prompts me to add a few words corroborating his statement as to the ease with which the flicker photometer is handled by observers unaccustomed to its use. If the lights to be compared differ at all in color, it is probably more easy to use, for the unskilled observer, than ordinary photometers, as the following experience, among others, shows. While I was experimenting, in 1895, with the revolving disk instrument to which Professor Rood refers, two chemists, in the course of an investigation, found it necessary to compare photometrically the illuminating powers of several different specimens of refined petroleum. I placed at their disposal a Lummer-Brodhun and a Bunsen Photometer, and showed them, as a matter of interest, the newly-devised flicker instrument. The standard lamp differed slightly in color from the flames given by the oils under investigation, so that the two observers found it somewhat difficult to obtain concordant results with either of the two ordinary photometers. They, therefore, reverted to the flicker instrument, using it to check all their results, finding its use, under the conditions, more agreeable and certain than either of the others.

With the Lummer-Brodhun or the Bunsen instrument they experienced all that unpleasant sensation of uncertainty which

attends the comparison of differently colored lights; each found it hard to make readings agreeing with the other, or even to verify the other's readings. With the flicker instrument these difficulties disappeared.

As Professor Rood says, there is little or no more difficulty or fatigue in the use of this instrument than in other optical observations, the approximate setting being quickly made, and the flicker near that point being so slight as not to disturb the eye, yet being distinct enough to require no especially strained attention, unless the illumination is too feeble. I may call attention here once more to the statement in my previous paper, that the method used by Professor Rood, of keeping the photometer and one lamp stationary, moving the other, has certain notable advantages in the use of this instrument, especially in the comparison of a number of lights differing greatly in color and in brightness, in that the standard light can be kept at a fixed distance from the photometer, and all the measurements made at the same absolute brightness, insuring about the same quality of flicker, and about the same degree of sensitiveness throughout.

The arrangement, however, is obviously not so sensitive as that in which both lights are stationary and the photometer itself is moved, and probably the latter method is generally preferable when the lights are sufficiently bright. It takes a little longer to make a setting with the flicker photometer than with others, and for this reason it is not easy to use upon an arc light, where the brightness is continually changing. This difficulty, of course, varies greatly with the character of the arc.

The essence of the flicker photometer lies in this, that the two fields to be compared are presented to the eye alternately, in rapid succession, and not as in other instruments simultaneously, and side by side. There is no attempt to compare the two lights. One simply notes the disappearance of a certain recurrent sensation. It is evidently necessary that the two fields compared should fill exactly the same portion of the whole visual field, and it is desirable that the time taken in transition from one field to the other should be as small a portion as possible of the whole time of observation, in order that the retinal shock, to which the 'flicker' sensation is due, may be sharp and sudden. I am inclined to think that the latter condition is more easily and completely met by a rotating than by an oscillating apparatus.

Professor Rood's form of the instrument possesses some advantages over the rotating disk. The faces of the large prism are rigid, and the same portion of each of them is always used. A rotating disc is thin, easily bent or distorted, and there is a possibility of difference in the character of the surface of different parts, which, since the whole of it passes in review before the eye, might cause a flicker between different portions of the disk itself. A flat disc of zinc, however, to which is firmly glued a sheet of white paper, gives but little trouble, and the line separating the two fields is rendered almost imperceptible by filing thin that edge of the disk which passes in front of the eyepiece. Again, the method of construction of the disk photometer makes it impossible that the two lights to be compared should be in the same line parallel to the photometer bar, an arrangement which becomes inconvenient if it is desired to change from this to another photometric apparatus. This difficulty is avoided in the oscillatory apparatus of Professor Rood.

I may mention here a form of the flicker photometer (described at the Detroit meeting of the American Association for the Advancement of Science, but not elsewhere published) which avoids some of the difficulties of the disk form and is more convenient for ordinary photometric purposes.

A short truncated cone is made of wood, and the conical surface carefully whitened. The approximate dimensions of the cone in my apparatus are: lower base, 20 cm.; upper base, 15 cm.; height, 3.7 cm. The cone is cut in two along the axis, one-half reversed in direction, and the halves fastened together in this new position. The whole is then mounted so as to rotate about the axis of the cone, which is placed parallel to the photometer bar.

The figure represents the photometer. L and L′ are the lights to be compared.

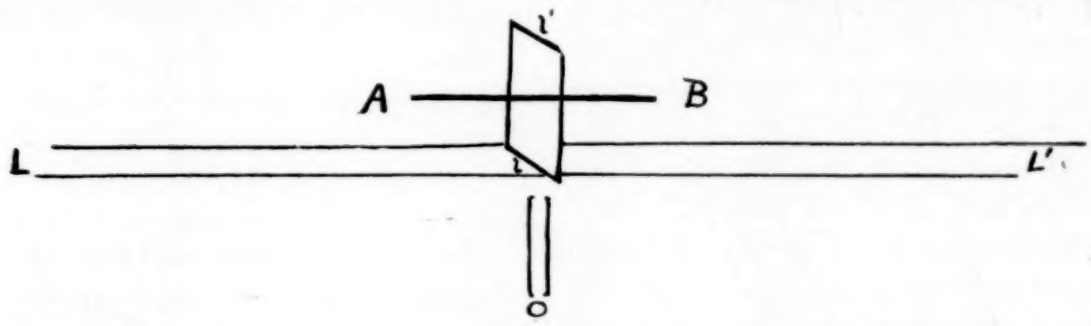


FIG. 1.

The cone, cut and reversed as described, revolves about the axis AB. The plane of division of the cone, as the figure is drawn, passes through this axis and is perpendicular to the paper. O is the eye-tube. When the instrument is in the position shown, *l* is in the field of view and is illuminated by the lamp L, but when the cone has made one-half a revolution *l′* is seen, which is lighted by the lamp L′.

While this instrument is compact and convenient for most photometric measurements, the disk form is superior for the comparison of pigments, as one of the fields consists simply of a card, which can be removed in an instant and replaced by another. Thus differently tinted papers can be easily compared in succession with the revolving disk, which may be of any color, but which in practice is generally white or gray.

I do not know whether it has been generally remarked that Captain Abney, in his careful measurements of the distribution of brightness in the spectrum, seems to have used a method of observation closely akin to the flicker method, though apparently without perceiving its definite character or possibilities. His well-known color-patch apparatus places side by side two differently colored fields, the brightness of one of which can be rapidly varied by opening or closing the apertures in revolving sectors. I quote the following from his Tyndall lectures, delivered in 1894:

"By gradually diminishing the range of the 'too open' to 'too close' apertures we arrive at the aperture where the two colors appear equally bright. *The two patches will cease to wink at the operator*, if we may use such an unscientific expression, when equality in brightness is established. This operation of equalizing luminosities must be carried out quickly and without concentrated thought, etc."

It seems probable that Abney, throughout these measurements, applied himself not so much to a careful comparison of the brightness of the two colors involved as to reducing to its faintest condition this *wink*, which differs little in its nature from a flicker.

FRANK P. WHITMAN.

BIOLOGICAL SURVEY OF LAKE ERIE.

ON July 1, 1898, the U. S. Commission of Fish and Fisheries will inaugurate a biological survey of Lake Erie, under the direction of Professor Jacob Reighard, of the

University of Michigan. Commissioner Bowers has allotted a liberal sum for the first season's inquiries, and will undoubtedly provide for a continuance of the work over several years. Professor Reighard will have associated with him Dr. H. B. Ward, of the University of Nebraska; Dr. H. S. Jennings, of the Montana College of Agriculture and Mechanical Arts; Dr. Julia Snow, of Ann Arbor; Mr. A. J. Pieters, of the U. S. Department of Agriculture, and a number of other assistants.

An elaborate plan for the study of the lake fauna and flora has been outlined and will be followed as closely as the circumstances permit. The work will extend over the entire year. Experimental work, similar to that conducted at agricultural experiment stations, will be a prominent feature of the survey, some of the problems to be considered being the rate of growth of fishes; the food of young fishes reared from the egg and the changes in their regimen during growth; the source of food of aquatic rooted plants; the life histories of food fishes reared in aquaria or ponds, and of certain aquatic insects and other invertebrates; the rate of increase of the plankton as a whole and of its individual constituents. There will also be systematic studies of the habits, migrations, distribution and food of the fishes and other organisms of the lake.

At the beginning of the work Professor Reighard and Dr. Ward will devote a considerable amount of time to plankton problems, especially the perfection of methods and apparatus; Dr. Snow will carry on experimental work on the algæ; Dr. Jennings will undertake experimental researches on the protozoa, and Mr. Pieters will pursue studies of the aquatic flora. The summer headquarters of the survey will be at the government hatching station at Put-in-Bay, South Bass Island, Ohio.

Lake Erie affords an excellent field for work of this character, on account of its varied fauna, diversified physical features, extensive fishing interests, and the recent serious depletion of the supply of certain valuable food fishes. The investigations may ultimately be extended to some of the other Great Lakes.

H. M. Smith.

U. S. Commission of Fish and Fisheries.

EUGÈNE FLACHAT.

The committee on the inauguration of the monument erected to the memory of Eugène Flachat, of the *Société des Ingénieurs Civils de France*, issued invitations to scientific and professional colleagues on both sides of the Atlantic. The ceremony took place June 12th, at Paris, at the intersection of the streets named for Brémontier, Alphonse de Neuville and Eugène Flachat. We glean the following from the circular issued by the committee:

Flachat, one of the most famous, and justly so, of French engineers, was the designer of the now familiar I-section of rolled iron or steel beam, universally employed in construction.

Flachat was born in 1802. He exhibited his genius for construction, and his inclination toward engineering as a profession, in earliest childhood. As a school boy he was called upon to check the mathematical work of his master, and as a youth investigated the proportions of parts of structures and machinery with the greatest completeness and success. He became particularly interested in metallurgy, constructed the largest blast furnaces and mills of the Ardennes, organized the forges at Commentry and, with Barrault and Petiet, produced a great work, now classic, on the metallurgy of iron which is known by their names. He wrote many articles and brochures, some on economics and related subjects. His main occupation was the construction of railways; but he published descriptions of

a great variety of other works, illustrating his versatility, his industry and his extensive interests. Inaugurating in France the era of railways, he also, as a sequence and as a part of that great work, had a hand in the perfection of their bridges and stations and locomotives and other rolling stock, and in all forms of related constructions, whether architectual or mechanical. He it was who, perhaps more than any other, created the systems of construction, organization and operation of the French railways. In 1848 he was called upon to rebuild the old wooden bridge at Asnieres, and showed his originality and boldness by reconstructing it in wrought iron, and, further, in rebuilding it and transferring traffic to it from the temporary construction improvised upon the burning down of the old bridge, without the delay of a single regular train. From that time the substitution of iron as a building material for wood, in his work, was a fruitful source of fame. He performed the, as then thought, most marvellous feats and always with success; for his computations were always accurate and based upon data ascertained by his own experiments and observations to be safe and correct. The framing of exposition buildings, in 1878 and in 1889, by Dion, his favorite disciple, and by Contamin, his follower, were illustrations of the methods of Flachat.

Flachat reconstructed the foundations of the cathedral of Bayeux, saved its central tower from imminent danger of falling, and restored the church, without accident or delay, and this after the experts consulted had declared the case beyond remedy. He there used a now common form of support, hollow iron columns, of large diameter, filled with concrete, as substitutes for the failing foundations.

The memorial erected in Paris is placed by his now few surviving pupils, aided by many friends and numerous admirers, as a testimonial of their appreciation of the service rendered by the great engineer to his country.

R. H. T.

CURRENT NOTES ON METEOROLOGY.

MOHN'S GRUNDZUGE DER METEOROLOGIE.

MOHN'S *Grundzüge der Meteorologie* has long been one of the favorite text-books of meteorology in Europe. Its author is well known as professor of meteorology at the University of Christiania and Director of the Norwegian Meteorological Institute. The book was first published in Norwegian, and was translated into German by the author himself, the last German edition (the 4th) bearing the date 1887. We now have a new German edition, the fifth (Berlin, Reimer, 1898), enlarged from 364 to 419 pages, and with several changes. Among the additions we note a description and a cut of the Assmann aspiration psychrometer and of the Richard thermograph. There is a new chart of mean annual ranges of temperature, and the other temperature charts are revised. Mention is made of so recent a phenomenon as the Paris *trombe* of September 10, 1896. The general arrangement of the book is the same as in the former edition, and there is, unfortunately, the same lack of an index.

VAN BEBBER'S WETTERVORHERSAGE.

THE present year brings us also a new edition, the second, of Van Bebber's *Wettervorhersage* (Stuttgart, Enke, 1898), the first edition being dated 1891. The book is now some forty pages longer than when it was first written, and a new chapter on weather forecasting for several days in advance has been added. The substance of this chapter was contained in a pamphlet by the author, published in 1896, under the title *Die Beurtheilung des Wetters auf mehrere Tage voraus.* The plan of the work is, in brief, to present by means of a large number of weather charts (over two hundred), arranged

systematic order, the common weather types and the succeeding changes which occur over Europe. After finding in the book a weather map which represents exactly or nearly the same conditions as prevail on any particular day, one can form a judgment as to the kind of weather that will probably obtain on the next day or two, by noting what weather changes took place under similar conditions before. In the chapter on forecasts for some days in advance, Van Bebber defines five common and easily recognized weather types, dependent upon the distribution of atmospheric pressure over Europe. The weather conditions which distinguish these five types may last for various lengths of time, according to circumstances, but they may often be counted on for three days and a half. When, therefore, one of these types is recognized as occurring, a fairly reliable forecast for three days ahead can frequently be made.

THE CLIMATE OF CUBA.

Bulletin No. 22 of the Weather Bureau, entitled *Climate of Cuba; also a Note on the Weather of Manila*, by W. F. R. Phillips, has evidently, as is stated in the pamphlet, 'been somewhat hastily prepared.' The Havana Observatory has given us most of what is definitely known about Cuban meteorology, in its series of annual volumes of observations. Apart from these, there are only fragmentary data. In the present bulletin reference is made to meteorological observations at Key West, Nassau, Port au Prince, San Juan, Porto Rico, and other neighboring places, in order to throw further light on the climatic conditions of Cuba. At Havana the mean annual temperature is 77° F., in round numbers. July has a mean of 82.4°; January has 70.3°. Santiago apparently has a higher mean annual temperature, viz., about 80°. From very fragmentary, and probably also rather unreliable, records made at Ubajay and the San Fernando mines, in the interior, the mean annual temperature appears to be considerably lower there than on the coast. The relative humidity is fairly constant at Havana, the average being 75%. The mean annual rainfall at Havana is 51.73 inches (based on records for 30 years). The rainy season begins late in May or early in June, and ends in October. 68% of the annual rainfall comes during these months, but in 30 years it has happened five times that the rainfall in the so-called dry season has equalled or exceeded that of the rainy season. The northeast trades are the prevailing winds, but these are occasionally interfered with by cyclonic winds. In winter, *northers* are felt along the northern coast of Cuba, these being due to the passage of cyclonic centers over the southern portion of the United States.

A few paragraphs at the end of the report, concerning the *Weather of Manila*, were compiled by Professor H. A. Hazen. The data relate to the observations made at the Manila Observatory. The mean annual temperature at Manila is 80° F. May, the hottest month, has 84°, and December and January, the coldest months, have 77°. September has 85% of relative humidity, and April, 70%. The mean annual rainfall is 75.43 inches, of which 50.74 inches fall in June–October. It is to be regretted that this bulletin was not made more complete, as the information it gives, especially concerning Manila, is very fragmentary indeed.

R. DeC. Ward.
Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

THE BUILDING SACRIFICE.

On all continents and in all ages when an important building is commenced or finished some kind of celebration takes place. Very generally it used to be a sacrifice, human, or of some lower animal. This

custom is the theme of a thorough study by Dr. Paul Sartori in the *Zeitschrift für Ethnologie*, Heft I., 1898.

Having demonstrated its wide extension he seeks for the psychical motives which prompt it. They are complex. Sometimes the offering was to the spirit of the place or to the gods for the undertaking; or it was to obtain a guardian divinity in the soul of the victim; or it was magical, by the spilling of blood to drive away evil spirits; or it was a procedure in sympathetic magic, the offering or victim being eaten with joy, so that joy should abide in the house; or the sacrifice was in some way vicarious, a substitute for what fate might otherwise demand of the house owner.

The article is a good example of exposition and analysis applied to a widespread rite.

THE CUSTOM OF 'DHARNA.'

THE legal practice in India of *Dharna*, or sitting at a debtor's door and not eating until the debt is paid, still obtains in that country and is as old as the laws of Manu. The debtor must either pay up or move away, or else the creditor will starve himself to death. This would seem to us a very silly proceeding on the part of the creditor; but Dr. S. R. Steinmetz, in a study of the custom printed in the *Rivista Sociologia Italiana* for January of this year, points out that when the meaning and origin of the usage are appreciated, it is by no means so foolish as it looks. Should the creditor die from hunger, the debtor is held responsible for murder, and the terrible penalties of blood revenge will be wreaked upon him by the family of the creditor. Not only the debtor himself, but all his kin or gens will become the targets of a merciless vendetta. With this certainty in view, any sacrifice on his part would be wiser than to allow the creditor to perish.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE MEETING OF THE AMERICAN ASSOCIATION.

A PROPOSITION to invite the American Association for the Advancement of Science to meet in Philadelphia in 1899 was referred by the Council of the Academy of Natural Sciences for consideration to a committee consisting of Messrs. Samuel G. Dixon, Thomas Meehan, Rev. Henry C. McCook, William Powell Wilson, Henry Skinner and Edward J. Nolan. After consultation with representatives of other scientific institutions and educational interests at a well attended meeting held in the Academy on the 22d inst., the following was unanimously adopted:

> As the first meeting of the American Association for the Advancement of Science was held in Philadelphia in 1848, and as it is fourteen years since the most successful meeting in its history was also held here,
>
> *Resolved*, That this meeting, in the belief that the second half century of the Association's career should begin in the city of its birth, approve of the suggestion that an invitation to meet in Philadelphia in 1899 be conveyed to the session to be held in Boston next August.

After a statement by Dr. Nolan regarding the successful methods of the local committee in 1884, and remarks in support of the proposition from Dr. Daniel G. Brinton, those in attendance signed a form of invitation to be transmitted to the Association in time to be acted on by the Boston session, and the Secretary was directed to obtain the signatures of representatives of the municipal government and others endorsing the movement but unable to be present.

The brilliant success of the meeting of 1884, and the desirability of starting the Association on its second half century under the most favorable auspices, after what will undoubtedly be a largely attended session in Boston, are sufficient reasons for the movement thus inaugurated. It is especially fitting that the preliminary steps should have been taken by the Academy of Natural Sciences, not only because of the honorable position it has always maintained in the scientific world, but also because the first meeting in 1848 was held within its walls. If the invitation to meet next year in Philadelphia be

accepted by the Association a satisfactory combination of scientific and social interest may be confidently anticipated.

AWARD OF THE LOUBAT PRIZES.*

THE undersigned, a committee appointed in 1895 to examine and report upon the various monographs submitted in competition for the Loubat prizes to be awarded in 1898, beg leave to report that they have carefully considered the different works received, and have also, in accordance with the rules governing the competition, examined such other works relating to American archæology as have been published in the English language during the three years ending with the first day of April, 1898. In their consideration of these monographs the Committee have taken into account not only the scientific value of the work, but also the importance of the subjects treated, the methods of investigation pursued by the authors, and the artistic and literary excellence of the presentation.

The monographs that were formally submitted for examination were the productions of eight different authors. Of these the committee have selected as being the most meritorious, and as most fully complying with the conditions prescribed for the competition, the treatise offered by Mr. William Henry Holmes, Curator of the Department of Anthropology in the National Museum at Washington. The title of this treatise is 'Stone Implements of the Potomac-Chesapeake Tide-Water Provinces.'

This volume may be held to mark an epoch in American archæological research, by interpreting the remarkably abundant artifacts of a typical region in the light of previous studies of actual aboriginal handiwork, and thus establishing a basis for the classification of the stone art of the entire western hemisphere. It is the result of many years of personal study, numerous experiments and close typographical analysis, and is supplied with a wealth of illustrative material that gives it most exceptional interest and value. The Committee, therefore, recommend that the first prize of $1,000 be awarded to Mr. William Henry Holmes.

*Report of the Committee to President Low, of Columbia University.

The elaborate monograph entitled *The Social Organization and Secret Societies of the Kwakiutl Indians*, by Dr. Franz Boas, of the Metropolitan Museum of Natural History of New York City, is a remarkably complete descriptive and analytic treatise setting forth the characteristics of a well studied tribe in such a manner as to offer a model for students and raise the standards of ethnological work. Its information is derived from personal research conducted on the very best scientific principles and dealing with a wealth of carefully collected material. Your Committee, therefore, recommend that the second prize of $400 be awarded to Dr. Franz Boas.

Of the remaining authors represented in the competition the Committee desire to single out for especial mention Dr. Karl Lumholtz, who presented a treatise entitled *Objective Symbolism of the Huichol Indians;* Mr. Frank H. Cushing, who offered a manuscript interpretive of aboriginal art and industry under the title *Tomahawk and Calumet, Shield and Gorget;* and Dr. Walter Hoffman, whose extended memoir embodies a careful study of the Menomini Indians.

The Committee desire also to mention with especial commendation a work by Alfred P. Maudslay, of London, dealing with the archæology of Central America. This work was not submitted by its author in the competition, and it has not yet been completed in publication; but its great merit is such as to demand some especial mention on the part of this Committee.

All of which is respectfully submitted.

Committee: H. T. PECK, *Chairman.*
D. G. BRINTON,
W J MCGEE.

MAY 21, 1898.

NEW GASES IN THE ATMOSPHERE.

A FURTHER communication of great interest on the occurrence of hitherto unsuspected elements in the atmosphere was made, according to the London *Times*, to the Royal Society by Professor Ramsay and Mr. Travers, on June 16th. Since the discovery of argon it has always been a question whether the gas isolated by Lord Rayleigh and Professor Ramsay was in reality a single uniform substance, a point which was very difficult to settle owing to the

impossibility of applying any ordinary chemical test. Moreover, as the molecular weight of helium—which shares with argon the peculiarity of being an entirely inert element—is four, whilst that of argon is almost 40, it appeared probable that an element of intermediate molecular weight remained to be discovered. Professor Ramsay and Mr. Travers have, therefore, prepared a large quantity of 'argon' from atmospheric nitrogen; separating this latter gas by means of magnesium, and having liquefied it by cooling with liquid air, they have then fractionally distilled the product. The first portion, consisting of less than one hundred cubic centimeters, distilled off from the liquid obtained by condensing 18 litres of argon, was found to have a density of about 13 instead of 20, which is that of argon; and its spectrum differed from that of the known gases, a yellow line, less refrangible than those characteristic of helium and krypton, being especially prominent. On continuing the distillation, after nearly the whole of the liquid argon had evaporated, a solid was obtained which only slowly volatilized. The gas into which this solid was converted was found to be of practically the same density as argon, but its spectrum was altogether different and peculiar, consisting for the most part of bands, not of lines. It is proposed to call the lighter element Neon, and that derived from the solid Metargon.

These observations, as well as those on krypton communicated to the Society the previous week, must obviously be regarded as but indications of the presence in various minute proportions of a variety of new substances, probably all elements, in the atmosphere. Further development of the investigations will be awaited with interest. The success which has thus far been obtained is striking proof of the great value of the new engine of research which liquid air affords, especially as diffusion experiments had failed to afford any evidence of the presence of such substances in our air.

CIVIL SERVICE EXAMINATIONS IN SCIENCE.

THE Civil Service Commission invites attention to the fact that no applications were filed for the examination scheduled to be held on June 7th for Assistant Curator, U. S. National Museum (Division of Mammals), Smithsonian Institution; and it announces that July 21st has been set for examination for the position mentioned, salary $1500 per annum. Applicants will not be required to appear before a board of examiners for examination, but they will be rated on the elements of education, experience, publications and a thesis, which are to be indicated upon special forms furnished by the Commission. These subjects will be weighted 10, 15, 50 and 25 per cent., respectively. The Department states that it is desirable that persons certified for this position shall be men not less than 25 nor more than 40 years of age and that they should possess a good general education (college graduates preferred); a general knowledge of zoology and a thorough knowledge of mammalogy, more especially as relating to the North American fauna; they should have a practical knowledge of field collecting, and of museum methods of preserving, arranging and labeling collections.

On July 14th an examination will be held to fill two vacancies in the grade of Assistant, U. S. Coast and Geodetic Survey, Treasury Department, the salaries of which are $1,200 per annum.

The examination will consist of the subjects mentioned below, which will be weighted as follows:

Knowledge of the operations of geodesy,	40
Experience in the work of a trigonometric survey,	40
Knowledge of field astronomy,	20

A statement of the experience in the work of trigonometric survey is to be submitted upon a special form, which will be furnished applicants with their application blanks. This statement must be filed with the application. Applicants for this examination must not be over 50 years of age.

No eligible candidates were secured from the examination held on May 6, 1898, for the position of Chief of Division of Library and Archives, U. S. Coast and Geodetic Survey, Treasury Department, and another examination will be held on July 21st and 22d. The salary of this position is $1,800 per annum.

The examination will be as follows:

Basis examination (spelling, arithmetic, penmanship, letter-writing, copying from plain copy, copying from rough draft—first grade),	15
Library economy,	30
Bibliography,	30
French and German,	15
Experience,	10

An examination will be held on July 21st, for the position of Assistant Chief, Division of Forestry, Department of Agriculture, at a salary of $1,800 per annum.

The examination will be as follows:

Forestry,	60
Botany,	5
French or German (translation into English of passages relating to forestry),	10
English (essay on a forestry subject),	5
Experience,	20

Another examination in the Division of Forestry will be held on July 28th, to fill the position of District Assistant at a salary of $1,200 per annum. The examination will consist of the subjects mentioned below, which will be weighted as follows:

Forestry,	60
Botany,	5
English (essay on a forestry subject),	5
Experience,	30

GENERAL.

In connection with the Congresses of Physiology and of Zoology, to be held in Cambridge next August, it is propossd to confer the honorary degree of Doctor of Science on Professor Bowditch, of Harvard; Dr. Anton Dohrn, of Naples; M. A. Milne Edwards, of Paris; Professor Golgi, of Pavia; Professor E. Haeckel, of Jena; Professor Hubrecht, of Utrecht; Professor Kowalevsky, of St. Petersburg; Professor Kronecker, of Berne; Professor Kühne, of Heidelberg, and Professor Marey, of Paris.

Professor K. von Röntgen, of Würzburg, has been awarded the Elliot-Cresson medal of the Franklin Institute of Philadelphia.

Dr. H. Molisch, professor of plant physiology of the German University of Prague, has returned after a trip around the earth for purposes of research, having made special studies in Java.

Dr. J. Hann, professor of meteorology in the University of Gratz, has been made honorary member of the Geographical Society of Lima, Peru.

Dr. Simon Schwendener, professor of botany in Berlin, has been made a knight of the order *pour le merite* in science and art.

The freedom of the city of Edinburgh was conferred on Lord Lister on June 15th.

We regret to record the death, on June 28th, at Munich, of Dr. George Bauer, associate professor of paleontology in the University of Chicago.

Dr. Theodor Eimer, the eminent zoologist, professor in the University of Tübingen, died on May 30th, aged 30 years.

The death is also announced of M. Souillard, professor of astronomy in the University of Lille, and a corresponding member of the Paris Academy of Sciences.

Mr. C. W. A. Hermann, a mineralogist, died in New York on June 21st, at the age of 97 years.

After all public works in New York City had been stopped, under the new city administration, we are glad to learn that the Board of Estimates and Apportionment has authorized the reissue of $375,000 in bonds for the construction of buildings for the Botanical Garden in Bronx Park. Work on the Museum Building is being carried forward, the contract calling for its completion early next year.

In addition to the comet discovered photographically by Mr. E. Coddington, of the Lick Observatory, and observed on June 11th, the light of which is said to be equal to that of a star of the magnitude of 7.7, Professor Perrine, of the Lick Observatory, discovered a faint comet on June 14th, and Mr. Hussey discovered Wolf's periodical comet on June 16th. The positions have been telegraphed by Professor Keeler, Director of the Lick Observatory, and are published in a special circular of Mr. Ritchie's Science Observer, issued on June 20th.

There is nothing in America corresponding to the civil list pension in Great Britain. There have been given during the past three years twenty-seven pensions under the British government, of which the following were in re-

cognition of scientific work: Mrs. Henrietta Anne Huxley, widow of Right Honorable Professor Thomas H. Huxley, scientist, £200. Dr. John Thomas, Arlidge, hygienist, £150. James Hammond, mathematician, 120. Oliver Heaviside, electrician, 120. Miss Anne Walbank Buckland, anthropologist, 80. Mrs. Fanny Hind, widow of Dr. John R. Hind, F.R.S., astronomer, 70. Mrs. Margaret Anne Houghton, widow of Rev. William Houghton, scientific writer, 50. Samuel Alfred Varley, electrician, additional, 50. Aug. Henry Keane, F.R.G.S., ethnologist, 50. Misses Frances Elizabeth, Mary and Julia Dobson, sisters of the late Surgeon-Major George E. Dobson, F.R.S., zoologist, each 25.

SURGEON-GENERAL STERNBERG has written as follows to the *Army and Navy Journal* regarding the danger of yellow fever in Cuba: "In your issue of April 23d, page 642, the statement is made that General Sternberg 'expresses confidence in the excellent sanitary provisions of the military service, and does not fear that yellow fever will prove more harmful to the troops than diseases which are common in the Northern latitudes,' etc. I have not expressed any such optimistic opinion, and regret to say that it is not justified either by my studies relating to yellow fever or by my personal experience. History teaches that when a considerable number of unprotected persons are exposed in a yellow-fever-infected locality during the months when this disease is most prevalent (May 1st to November 1st, in the latitude of Havana) an epidemic almost infallibly results. In the last week of April of last year there were 17 deaths and 70 new cases of yellow fever in the city of Havana. Now, suppose that we had a similar number of cases at the same season in New Orleans and that 20,000 strangers from the North should go there to spend the summer, what would be the result? All past experience supports the belief that a majority of them would have yellow fever, and that from 20 to 40 per cent. of those taken sick would die. This is what I anticipate would happen if we should send an army to occupy Havana, or any other infected seaport on the coast of Cuba during the summer months. If, however, these troops could be camped upon high land in the interior, and circumstances were such as to enable them to comply with all of the exactions of modern sanitary science, I am of the opinion that our loss from yellow fever would not be serious. But in time of war military commanders are expected to take their troops to the points occupied by the enemy, and a picnic in the interior with frequent changes of camp, etc., is perhaps not exactly what we may expect. I am not an alarmist, but I believe in looking facts fairly in the face and cannot allow your statement of my opinion to have currency at such an important moment in our country's history without a protest."

UNIVERSITY AND EDUCATIONAL NEWS.

TWO of the conditional gifts of $50,000 offered by Dr. D. K. Pearsons have been secured by the colleges collecting the additional sums required. The endowment of Beloit College is thus increased by $200,000 and that of Mt. Holyoke College by $150,000.

THE sum of $50,000 has been given from a source not named to Amherst College for an academic hall, to be built in honor of President Seelye. The class of '95 of Amherst has collected $24,000, with which a laboratory building will be erected.

THE University of Virginia has received $20,000 from Henry L. Higginson, Treasurer of the J. W. and Belinda Randall Charities Corporation of Monson, Mass., to be used for the erection of a building or as a permanent fund.

A BENEFACTOR of Edinburgh University, who desires for the present that his name should be withheld, has given the University such a sum as may be necessary, but not exceeding £10,000, to build and equip a laboratory and class-room to be used for the teaching of public health.

DR. MERRILL E. GATES has resigned the presidency of Amherst College.

DR. CHARLES HARRINGTON has been appointed assistant professor of hygiene, and Dr. Franz Pfaff instructor in pharmacology and physiological chemistry, in Harvard University.

ROLLINS A. EMERSON, of the Department of Agriculture, and a graduate of the University of Nebraska, has been elected to the assistant professorship of horticulture in his *alma mater*.

He is to assume the duties of the position in April, 1899.

On the recommendation of the General Board of Studies of Cambridge University a University lectureship in chemical physiology was established without a stipend for the present.

DISCUSSION AND CORRESPONDENCE.

ON THE EARLY SENSE OF SELF.

To the Editor of Science: Professor G. Stanley Hall, in the last *American Journal of Psychology*, asks (p. 354) some questions on the early sense of self, which we may briefly answer on the basis of evolutional psychology.

1. "In the first contact of hand and mouth does the latter feel the former first and most, or *vice versa*?" We answer that the mouth feels the hand first and most, because the mouth is the earlier integrated tactual organ in the history of life. The hand as locomotive organ modified for grasping, only gradually becomes tactile in the race and individual. The hand is merely one object of the many which the child brings to the mouth for interpretation, and so it mouths the hand rather than handles the mouth. The child comes by the peculiar plexus of sensations involved to understand its hand as a different kind of object from its rattle, namely, as a self-object, a part of the somatic self.

2. "Does the eye first find the hand because the eye moves, or because the head moves, and does a motor or a sensory process lead?" As head-moving as method of vision direction is earlier integrated than eye-moving, we should expect the infant to employ head-moving first, and most largely for some time; and for the same reason motor process would lead. We should expect (as p. 351 instances) that the child would first have its attention called to its hands, not through sensations therefrom like temperature or muscular, but by a general movement of hands happening to occur in the field of vision. More thorough studies of infants with reference to head-moving and eye-moving ought to be made, and especially to learn at what age its attention may be directed to its fingers by, *e.g.*, merely pinching them.

3. "What social and ethical factors are involved in the child's scolding and punishing naughty hands?" The social factor, imitation, is evident, and the ethical factor of the responsibility of the hand for its own acts before it is fully incorporated into the somatic self is also evident. The child who says, when reproached and punished for pushing over a vase, 'I did not do it, hand did it,' is not necessarily falsifying, but often telling the exact truth about the instinctive independency of the hand in its impulse to grasp and push. The child has no memory of acting through his hand, and practically did not, and hence properly blames and punishes the hand. Far more than the adult realizes, the hand with the very young acts in grasping, touching, etc., instinctively and independently, and only very gradually comes in action to be a part of the real self. The parent who exclaims to the child: 'naughty hand!' and punishes the hand, only helps to keep apart in the child's mind the hand-self and the real self; whereas the child should be helped to incorporate its organs into its real self as fast as possible. Pedagogically this is a matter of considerable importance.

4. "Have we, so far, instinct, feeling, will, reason, attention, or mere automatism?" The earliest sense of self in child life is, no doubt, instinctive, in that it comes spontaneously at the impulse of a vast heredity. A reference of all things to the self, a constant interpretation of environment as to its action on the self, is implied in the whole struggle of existence, and strengthens till it becomes thoroughly integrated, that is, becomes instinct. It is plain that the self-unconscions, self-forgetful animal would not have the least chance of survival; but a continual alertness for self is the prime requisite, though the self at the first is undoubtedly very indefinite. The child in its earliest, most subjective experiences, wherein is the merest glimmer of object, namely, in the primitive flashes of pain and pleasure, awakes to itself, and its general struggling repeats earliest life. In these subjective experiences the child builds an *ego* long before it constructs a definite somatic self of hands, feet, etc., which, indeed, are not felt as me, but mine. That is, the somatic self is not the primary and real self, but the child learns the several members as standing in a peculiar relation to its own ex-

periences, and makes the members modes of itself. But while the child *learns* its members most animals appear to be instinctively aware of their somatic self in its parts and so to use them from the hour of birth. But only through the piecemeal learning of the somatic self does there come a full and strong sense of self. The man's hand is more really and fully his than is the crab's claw its claw. Self-conscious self-consciousness and all the high egoism comes of learning. However, the child learns itself in hand, foot, etc., by instinctive impulse, just as it learns to walk instinctively; but the learning, of course, implies attention, will, reason and feeling.

HIRAM M. STANLEY.

LAKE FOREST, ILL., June 16, 1898.

COLOR VISION.

IN regard to the points concerning which Professor Titchener considers that I have not correctly represented what he had to say on color theories in his letter in SCIENCE of June 17th it is so easy for the reader of SCIENCE to form his own opinion, if he is sufficiently interested in the subject to compare that letter with my reply to it, that there is no occasion, fortunately, to prolong the discussion. Since Professor Titchener has given so much attention to optics during the past year as he says he has done, he must plainly be much more familiar with the subject than most of the psychologists have time to be, and I have certainly hit it off very badly in accusing him of ignorance.

C. LADD FRANKLIN.

SCIENTIFIC LITERATURE.

Organographie der Pflanzen, in besondere der Archegoniaten und Samenpflanzen, I. Teil. K. GOEBEL. Jena, G. Fischer. 1898.

This first part of Dr. Goebel's Plant Organography has been awaited with impatience by many botanists who knew that such a work was in process of construction. Now, that the first half of the treatise is off the press, it can already be understood what an important and timely contribution to botanical literature is this latest work by certainly the foremost German plant morphologist, if not absolutely the foremost in the world. In reading through the attractive pages one is impressed, first of all, by the charming lucidity of the literary style, then by the freshness of the illustrative material, then by the perfect mastery of a wealth of detail and accessary or incidental matter, and finally by the philosophical and unpolemical tone of the whole. Professor Goebel has succeeded in bringing together from his own voluminous researches, and from the byways as well as the highways of botanical literature, a most interesting and suggestive volume. His general point of view is not at all new, for the foundation of organ-evolution is sought in adaptation rather than in the spirit of the recent *Entwickelungsmechanik*. Strong antagonism is manifested to the archaic 'ideal-philosophy' or 'nature philosophy' of Goethe and Herder, which one would think, from the somewhat unnecessary space given to its annihilation, must exist somewhere in the vicinity of Munich. The Goethean concept of the leaf, the stem, the flower, as in some mysterious sense types, or ideal plans, is generally so extinct that there seems scarcely justification for seriously girding at it. Goebel points out, truly enough, that there is no such thing as a *leaf* rudiment, but only bud-scale rudiments, sporophyll rudiments, cataphyll rudiments, foliage-leaf rudiments, etc. The leaf and the leaf rudiment are pure abstractions. But this does not seem to the reviewer so strong a position upon which to found a theory of metamorphosis as at first it did. It is true, Goebel's doctrine of pure metamorphosis is based upon just this conception of rudiments, and hence the position is important if one wishes to understand his work.

It would seem that one has quite as much right to insist that there are no bud-scale rudiments, but only willow bud-scale rudiments, poplar bud-scale rudiments, walnut bud-scale rudiments, cherry bud-scale rudiments, etc. Thus the bud-scale rudiment becomes, by the same process of reasoning, quite as vague an abstraction as does the leaf rudiment. As a practical proposition, Dr. Goebel's willingness to substitute analogy for homology in the foundations of botanical terminology cannot have much weight, for everywhere it is the phylogenetic test that is regarded as final, and analogies are rightly regarded as of secondary importance in

all taxonomic systems. But terminology must, in general, be of a sort that can be employed in systematic botany as well as in the departments of pure morphology or organography.

The attempt to construct an organography of plants upon adaptational or epigenetic lines must always be fraught with difficulties, some of which the author has not successfully avoided, but in general the work is most illuminating. A particularly useful chapter is that on symmetry, in which, it should be noted, there is included an independent paper by Dr. A. Weisse on the mechanical principle involved in leaf arrangement. The somewhat variant views of Schwendener and Vöchting are given due weight and discussed with much critical acumen. The part of this chapter dealing with the dorsiventral shoot is one of the few really satisfying chapters in botanical literature. Anisophylly, asymmetry and plagiotropy in general are given a most adequate and instructive treatment. Various species of *Selaginella* are reviewed, and the laws of leaf arrangement upon dorsiventral shoots are largely explained from plants of this one genus.

Of all five chapters, however, the third seems to the reviewer, upon the whole, the most original and valuable. Here Dr. Goebel incorporates his own results to a very considerable degree, and gives the first connected and philosophic account, in botanical literature, of seedlings. After his fashion in his earlier work upon plant development, he includes in the same breath discussion of gametophytic and sporophytic structures—a feature very repugnant to the reviewer—but, nevertheless, manages to leave no point untouched by a wealth of allusion and example, so that when the chapter is finished the reader feels that he never understood seedlings before. The spirit of the enquiry is altogether different from the drier and essentially formal tone of Sir John Lubbock's well-known book. It is philosophical, suggestive and inspiring.

Nothing particularly new or strikingly helpful is to be found in the closing chapters of the first part—those on malformations and on correlation—for the positions taken are quite exactly those of Sachs, and differ principally from Sachs, in treatment, by the examples chosen.

In general this work is one which will be everywhere regarded as well maintaining the transcendant reputation of its author.

Conway MacMillan.

University of Minnesota.

A Course in Experimental Psychology, Part I.: Sensation and Perception. By Professor Edmund C. Sanford. Boston, D. C. Heath & Co. 1898.

Professor Sanford has achieved a difficult task. A laboratory course may be most carefully planned beforehand, but upon trial it will be found quite inadequate in numberless ways; it is only after repeatedly using the course with successive classes, and most carefully correcting and improving it each time, that there is any reasonable security for the hope that the exercises will work smoothly. This series of elementary experiments is the successful result of many years of development in Professor Sanford's laboratory course at Clark University.

The earlier portion of the book (first published in 1894) covers the dermal senses, the kinæsthetic and static senses, taste, smell, hearing, the eye, light and color. The later portion (just issued) treats of visual perception. Some few of the exercises are rather physiological than psychological, but there is no objection to touching upon related problems; even books on physics are accustomed to discuss briefly the anatomy of the eye and the optical illusions. The experiments begin with qualitative ones of a most elementary character; *e.g.*, "Touch yourself in several places with the same object, and analyze out, as far as you can, the particular quality of the sensation by which you recognize the place touched. This quality of a sensation is known as its 'Local Sign.'" A few pages further the experiments become somewhat more elaborate; still further they require apparatus, and so on. In fact, they are carefully graded to increasing difficulty, without ever becoming too difficult for an elementary class. The suggestions in regard to apparatus are, in general, good, although some improvements might be made here; *e.g.*, it is doubtful if the joint-sense apparatus or the Ellis harmonium is worth the cost; if the large wooden pieces, such as tilt board and rotation table, are worth either the cost or the space, etc. The

steel cylinders referred to on p. 381 are quite accurately tuned by Koenig by a special method. In general, it may be said that one of the most expensive ways of getting pieces of apparatus is to have them constructed by 'any carpenter;' *e.g.*, the time required to explain the construction of the Wheatstone stereoscope to an ordinary carpenter, the inevitable use of unseasoned wood, and the high wages demanded by the American workman, make the result ruinously expensive. Successful apparatus can be furnished at reasonable terms only by a conscientious workman under the supervision of the scientist. Can we not hope that Clark University will again add to its reputation by establishing a special mechanic who can make the material for this course under Professor Sanford's personal supervision? This will aid in the introduction of elementary laboratory work throughout American institutions.

In conclusion, it would be hard to overestimate the labor, care and skill that show themselves in every line of Professor Sanford's book; as an elementary laboratory course it is not only a pioneer—it is at the same time a brilliant success. It is to be hoped that this Part I. will be followed by a Part II., which shall serve as a second-year course of a quantitative character; the subject of Time—which has been, I believe, promised for this part—lends itself readily and elegantly to this method of treatment.

As an episode in the history of science this book marks the introduction into psychological work of the elementary qualitative laboratory method which has, for example, been so successful in chemistry; it also bears some resemblance to elementary courses in physics given in some high, normal and grammar schools. It is, of course, not intended that such laboratory work should form the whole of the psychological instruction; a more general treatise would probably be read at the same time, such as Ladd's *Outlines of Descriptive Psychology*, or Titchener's *Primer of Psychology*, or, possibly, my own *New Psychology*, with the omission of the couple of difficult chapters on statistics and color. This elementary qualitative work should be followed by most carefully planned exercises in elementary psychological measurements; at Yale such a set of thirty exercises has been designed to teach such elementary concepts and methods as 'average,' probable error,' 'function,' 'plotting,' determination of constant errors, compensation of progressive errors, in addition to the usual psychological concepts and observations in touch, hearing, sight, time, etc. This course, in turn, should be followed by advanced work in psychological measurements analogous to that in astronomy, geodesy, etc.; such a course includes a discussion of probabilities, statistics, least squares, etc., and their application to psychological work. With the completion of Professor Sanford's book and the appearance of more advanced laboratory manuals we may hope to find the methods of instruction as well systematized in psychology as in physics or chemistry.

E. W. SCRIPTURE.

SCIENTIFIC JOURNALS.

The Journal of Geology for April–May, 1898 (Vol. VI., No. 3), contains the following papers: 'Chemical and Mineral Relationships in Igneous Rocks,' by Joseph P. Iddings. Professor Iddings continues the interesting discussion of the chemistry of igneous rocks by means of plotted curves, which was begun in a previous number. He first establishes the formulas and molecular ratios of the chief rock-making minerals. Next from a series of diagrams which are plotted by using silica-percentages as abscissas and the ratio of the molecular ratios of alkalies to silica as ordinates for a great number of rock analyses, illustrations and curves of extreme mineralogical composition are drawn. They serve very neatly to localize and group within limits many rock analyses of more complex relationships and cast much light on the minerals that must result in the crystallization of maqueas whose composition is known. 'The Weathered Zone (Yarmouth) between the Illinoian and Kansan Till Sheets,' by Frank Leverett. This weathered zone is most pronounced and best recognized in the region between Davenport, Iowa, and Quincy, Ill. Its character is illustrated by various well-sections. 'The Peorian Soil and the Weathered Zone (Toronto Formation),' by Frank Leverett. A bed of muck and weathered soil, for which the

name 'Peorian' is suggested, lies between the Iowan and the Wisconsin till sheets. It is provisionally correlated with the earlier named Toronto beds of peat, etc. 'A Geological Section Across Southern Indiana, from Hanover to Vincennes,' by John F. Newsome. A very excellent geological section has been prepared and plotted, but in the illustration the scale is so reduced that the sections are practically illegible. One can only make them out with a magnifying glass. The letter-press describes the formations and their relations to the topography. 'Notes on the Ohio Valley in Southern Indiana,' by Arthur C. Veatch. The paper discusses the phenomena of the development of the present drainage in Spencer County, Ind., along the Ohio, and incidentally throws light on the relations of the continent to the sea during the formation of the Lafayette beds. 'The Brown or Yellow Loam of North Mississippi and its relation to the Northern Drift,' by T. O. Mabry. After defining the loam the author discusses its strategraphic relations to the underlying Lafayette and the Loess or Bluff formation, which is regarded as an equivalent. The origin and age ef the Loess-Loam concludes the paper. It is regarded as a flood-plain deposit of glacial débris, more or less worked over by the wind. 'Classification of the Mississippian Series,' by Stuart Weller. The paper is a valuable review of the subdivisions proposed for the Mississippian and indicates the portion of the continent over which each prevailed.

The *Physical Review* for June, the last number of the sixth volume, publishes as frontispiece a portrait of the late Professor William A. Rogers, of Colby University. It also contains an obituary notice of Professor Rogers and a bibliography of his contributions to science, including 61 titles. Other articles in the number are: 'On the Surface Tension of Liquids under the Influence of Electrostatic Induction,' Samuel J. Barnett; 'On the Fall of Potential at the Surface of a Metal when exposed to the Discharging Action of the X-Rays,' Clement D. Child; 'An Experimental Determination of the Period of Electrical Oscillations,' Arthur Gordon Webster.

Terrestrial Magnetism for June, 1898. The first article, by Professors Elster and Geitel, describes a method for determining the upward or downward direction of vertical electric currents in the atmosphere by means of atmospheric electric observations. These observations serve as a control upon the results obtained from magnetic observations made at the same time. Professor Abbe continues his article on 'The Altitude of the Aurora above the Earth's Surface.' The present installment gives a chronological summary of the results obtained up to date since Dalton's time. Mr. Putnam gives an interesting summary of Professor Eschenhagen's investigations of the magnetic anomalies in the Harz Mountains. Relations with reference to geological structure and with regard to deviations of the plumbline are discussed and cartographically exhibited.

In the next article Professor Eschenhagen discusses the electric car disturbances felt by magnetic observatories. The Potsdam Magnetic Observatory insists that no electric railways using the earth as a return circuit be allowed within a radius of fifteen kilometers.

Letters to the Editor and reviews conclude the number.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON.

The 103d regular meeting of the Society was held on May 12, 1898.

The first paper of the evening was presented by Messrs. F. K. Cameron and H. A. Holly, and was entitled 'Acetone-Chloroform, 1st paper.' Acetone-chloroform is produced by bringing together acetone and chloroform and adding powdered potassium hydroxid to the cooled mixture in small portions at a time, allowing to stand until the reaction is completed and fractionating the fluid products. The experiments which are described by the authors have led them to the following conclusions:

I. The existence of but one acetone-chloroform, a white, crystalline solid, a derivative of tri-methyl-carbinol.

II. The substance is not a simple addition product and cannot be resolved into its original constituents by direct means.

III. The substance forms no definite hydrate.

IV. The temperature of the quadruple point

for solid, two solutions and vapor in the system acetone-chloroform-water, is 75°.2.

V. The melting point is near, but above 97°, and in all probability perfectly anhydrous material has not yet been obtained.

VI. The system acetone-chloroform-water seems to present the remarkable case of a solid solution and two liquid solutions.

The next paper was presented by Messrs. P. Fireman and E. G. Portner, and was entitled 'The action of normal propyl alcohol on phosphonium iodid.'

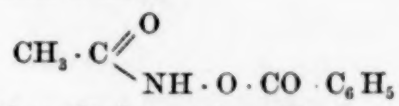
The authors, having undertaken to fill up some of the most important gaps in our knowledge of individual phosphines, communicated as the first contribution the method by which they prepared tri-n-propyl phosphine and tetra-n-propyl phosphonium iodid, and described the properties of these bodies.

Messrs. F. K. Cameron and E. F. Thayer presented a paper on 'The boiling point curve for benzene-alcohol solutions.'

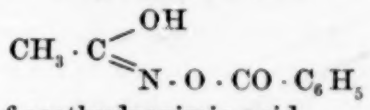
When a mixture of pure benzene and alcohol containing more than 66.5 per cent. of benzene is partially distilled, it will yield a distillate richer in alcohol. Complete fractional distillation will yield a mixture with a minimum constant boiling point of 66°.7 and containing 66.5 per cent. of benzene and a residue of pure benzene. If the original solution contained less than 66.5 per cent. of benzene it will yield a distillate richer in benzene, and complete fractioning will ultimately yield a distillate of the constant boiling solution and a residue of pure alcohol. Under no circumstances can a complete separation of the two compounds be obtained by any process of distillation.

The last paper of the evening was presented by Mr. F. K. Cameron and was entitled 'The benzoyl-ester of acethydroxamic acid.'

The benzoyl-ester of acethydroxamic acid was obtained by Jones as a product of the reaction between sodium isonitroethane and benzoyl chlorid. If ligroin be added to the mother-liquor obtained by the crystallization of the substance from ether another compound is precipitated, isomeric with the first. The isomer is on standing gradually but completely converted into the first modification. Jones regards it as a probable ester of acethydroximic acid, the relative orientations of the molecules being indicated thus:



Ester of acethydroxamic acid.



Ester of acethydroximic acid.

The authors have studied the two modifications, designating, for purposes of convenience, the former as the a-compound and the latter as the β-compound, and have arrived at the following conclusions:

I. Both modifications exist in the liquid phase.

II. The a-, or less fusible modification, is the stable one at ordinary temperatures.

III. Crystals of the β-compound can be obtained by dissolving the a-compound and precipitating the ester suddenly from solution.

IV. The equilibrium concentration changes with the temperature.

V. The a-compound is converted into the β-compound with absorption of heat.

VI. By raising the temperature of the system and cooling suddenly the point of solidification may be brought below the stable triple point. It was not possible to realize the eutectic point in this manner because of decomposition of the substance.

VII. The eutectic point of the system was shown to be below 66°, and is near 65°.

WILLIAM H. KRUG,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, JUNE 7.

MR. STEWARDSON BROWN made a communication on plants recently collected by him in the neighborhood of Canogo Lake, Pennsylvania. He described the location and character of the lake, which has an elevation of 2,360 feet, with the finest surroundings of virgin timber in the State. Among other peculiarities of the flora the almost entire absence of blue violets and the profusion and size of *Viola blanda* were noticeable. It was interesting to observe a flora corresponding to our own but with entirely

different species. Illustrative specimens were exhibited.

Attention was called to a collection of exquisite drawings of Australian flowering plants exhibited to the meeting by Mrs. F. C. Rowan. The Secretary thanked Mrs. Rowan on behalf of the Academy for the opportunity of examining the paintings, which are not only of high artistic value, but of great interest botanically on account of their accuracy of delineation and coloring. The artist has represented upwards of five hundred species, many of which were brought by her for the first time to the knowledge of the late Baron Ferdinand Von Müller, in whose collection specimens of all the plants represented were placed. The work was performed under unusually favorable circumstances by Mrs. Rowan, who cruised among the Australasian islands in a small steamer chartered for the purpose, the result being a collection of drawings of altogether extraordinary beauty and botanical interest as representing probably the most gorgeous flora in the world. Mrs. Rowan is now preparing similar illustrations of American plants. While the material at her disposal is not so striking, the results will, without doubt, be equally artistic.

Professor Henry Pilsbry spoke of the scientific work of the late Professors Jules Marcou and Fridolin Sandberger, correspondents of the Academy, whose deaths were announced at the meeting.

At the meeting on June 14th the Entomological Section having precedence, Dr. Henry Skinner made a communication on a collection of lepidoptera and other orders of insects, illustrating variations in size, peculiarities of coloring and habits, structure, sexual diversity, protective mimicry, etc. Other illustrations were shown by means of lantern and screen.

Mr. Philip P. Calvert spoke of mimicry and its relation to so-called natural selection. The two kinds of mimicry, known as Batesian and Muellerian, were defined.

Professor H. A. Pilsbry called attention to a collection of land shells from the arid region of central Australia. Their distribution resembles that of species from an island-dotted sea, the desert land being supplied with fugitive lakes in the surroundings of which the species are found. They are mostly ground species and their distribution is not affected appreciably by birds. They are probably survivors of a less arid time.

Professor Carter described a method of his own for the destruction of the round-headed apple-tree borer. He sprays the burrows with carbon bisulphide by means of a common atomizer and then covers the openings with soft clay. While the grubs are in every case destroyed, the trees are not affected.

Papers under the following titles were presented for publication:

'List of fishes collected at the Canary Islands by Mr. O. F. Cook, with descriptions of four new species,' by David Starr Jordan and James Alexander Gunn, Jr.

'*Hyalodendron navalium*, a new genus and species of Euplectillid sponge,' by J. Percy Moore.

The type of the genus and species described in the latter paper is one of a small collection of silicious sponges gathered in Japan in 1893, by Mr. Frederick Stearns, of Detroit, and sent to the Academy for determination. They were collected by native fishermen and brought into Yokohama harbor by the dredge boats. The single specimen of *Hyalodendron* is the only one which has been reported. The specimens are accompanied by a set of sketches by a native artist.

Edw. J. Nolan,
Secretary.

NEW BOOKS.

A Laboratory Guide in Qualitative Chemical Analysis. H. L. Wells. New York, John Wiley & Sons; London, Champman & Hall, Ltd. 1898. Pp. vii + 189.

A Short Course in Inorganic Qualitative Analysis for Engineering Students. J. S. C. Wells. New York, John Wiley & Sons; London, Chapman & Hall. 1898. Pp. vi + 293.

Technical Mycology. Franz Lafar. London, Chas. Griffin & Co.; Philadelphia, Pa., Lippincott. 1898. Vol. I. Pp. xviii + 405.

The Art of Taxidermy. John Rowley. New York, D. Appleton. 1898. Pp. xi + 244.